

# **Ecological Surveys**

## **An Environmental Inventory of the Armand Bayou Coastal Preserve**

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The goal of this report was to gather and integrate existing data, identify data gaps, and describe the environmental attributes of Armand Bayou relevant to the development of a management plan for the Armand Bayou Coastal Preserve. Armand Bayou can be influenced by events anywhere within, as well as beyond, its watershed.

The physical characteristics of the coastal preserve area have changed drastically due to five to nine feet of land-surface subsidence across the watershed since 1906. The lower reach of the bayou has changed from a wetland-bordered freshwater stream to a brackish tidal lake nearly devoid of wetlands. Mud Lake has expanded from 100 acres in 1956 to more than 325 acres today. All of the 275 acres of wetlands present in 1956 have been lost; replacement wetlands, of a different nature, amount to 24 acres, for a net loss of 91 percent.

The water quality of Armand Bayou is poor. It is ranked as the second-highest stream on the Texas coast for hypoxia, a condition of low oxygen produced by algae responding to elevated nutrient levels. Annual and monthly levels for total and ortho- phosphorus are persistently above thresholds characteristic of eutrophic streams. Ammonia and nitrate nitrogen exceed eutrophic thresholds during the cooler months but appear to be removed from the bayou by accelerated algal growth during warm months. Fecal coliform bacteria are a problem of long standing. No investigation of toxicants in the water or sediments has been undertaken.

The 60 square mile (38,400 acre) watershed receives 48 inches of rainfall annually and contributes approximately 80,000 acre-feet (71.4 million gallons per day, mgd) of freshwater inflow to Clear Lake. This rainfall varies greatly, even between localities very close together, and episodes of exceptionally heavy precipitation occur. Most of the watershed lies within the city limits of Pasadena, Deer Park, La Porte and Houston and has 38 percent residential-urban and six percent industrial land use. Point source discharges have declined in number, from six to three, but the volume of wastewater discharged has increased 35 percent, to 6.2 mgd, over the past decade. Point source stormwater discharges were 1.8 mgd in 1989.

Controversial issues in recent years have involved the accelerated and increased delivery of residential-area stormwater to the bayou and the removal of irrigation water from the bayou. The current water quality monitoring station at Bay Area Boulevard does not reflect the input of nutrients and pollutants from Horsepen Bayou, a major tributary which receives the bulk of treated wastewater effluent discharged into the bayou. The quarterly or semi-annual monitoring of recent years is inadequate to determine stream conditions. A 24-hour water quality survey during the warm season is needed to determine the extent of oxygen sag

during hours of darkness. An additional monitoring station that will reflect the contribution of pollutants from Horsepen Bayou is needed. Monthly sampling should be resumed for two to three years to establish an adequate baseline of information. An investigation of toxicants in water and sediment samples should be conducted.

The flora and fauna of Armand Bayou are poorly known and population trends cannot be determined from existing data. The freshwater biota upstream of Bay Area Boulevard, and in the tributaries, is virtually unknown. The lower reach is potentially a valuable nursery habitat for certain commercial and recreational finfish and shellfishes. A survey of these species in Mud Lake should be undertaken. The extent of bottomland forest flooding and value of this forest habitat as a contributor of detritus and nutrients, and as a sink for nutrients and pollutants, should be determined.

## An Environmental Inventory of the Christmas Bay Coastal Preserve

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The goal of this report was to gather and integrate existing data, identify data gaps, and describe the environmental attributes of Christmas Bay relevant to the development of a management plan for the Christmas Bay Coastal Preserve. Christmas Bay can be influenced by events anywhere within its watershed.

Christmas Bay remains a near-pristine, 5,660-acre habitat worthy of Coastal Preserve protection. There are no known water quality problems, nor indications of potential water quality problems, in Christmas, Drum, or Bastrop Bays. The current water quality monitoring program is inadequate, however, in that the monitoring station at Christmas Point does not reflect conditions within Christmas Bay and samples are collected infrequently. Freshwater inflow is estimated to be 63,500 acre-feet per year, with point source discharges from permitted outfalls contributing 7.7 percent of the volume. It is recommended that one or more additional water quality monitoring stations be established. Sampling should be conducted monthly for at least two years to establish current baseline conditions, and quarterly, at a minimum, thereafter.

Christmas Bay is inhabited by 96 fish species, 68 crustacean species, 140 mollusk species, and numerous other invertebrate animals. Existing fisheries data, collected for other purposes, is inadequate to determine fisheries trends within Christmas Bay. The Christmas Bay complex is an important finfish and shellfish nursery area and a monitoring program designed specifically for the complex would provide useful information regarding the natural variability in fisheries productivity.

Christmas Bay harbors eight endangered or threatened species - bald eagle (*Haliaeetus leucocephalus*), brown pelican (*Pelecanus occidentalis*), peregrine falcon (*Falco peregrinus*), whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), reddish egret (*Dichromanassa rufescens*), white-faced ibis (*Plegadus chihi*), and green sea turtle (*Chelonia mydas*) - while three additional species - wood stork (*Mycteria americana*), white-tailed hawk (*Buteo albicaudatus*), and swallow-tailed kite (*Elanoides forficatus*) - inhabit the adjacent Brazoria National Wildlife Refuge. Seven waterbird nesting colonies surround the bay. Potential exists to create a colonial bird nesting island, of sufficient elevation and vegetated with suitable substrate, to stabilize and enhance colonial wading bird productivity.

The peripheral emergent wetlands experienced a 8.4 percent loss in total acreage of emergent vegetation between 1956 (4,701 acres) and 1979 (4304 acres). However, changes in wetland vegetation type are difficult to interpret from the existing wetland maps. The seagrass meadows, composed of four species - shoal grass (*Diplanthera wrightii*), widgeon grass (*Ruppia maritima*), clover grass (*Halophila engelmanni*), and turtle grass (*Thalassia testudinum*) - are the most

valuable and productive habitat associated with the bay. Only widgeon grass is found elsewhere in the Galveston Bay ecosystem. The seagrass meadows have declined 36 percent in area, from 299 acres in 1956 to 191 acres in 1987, at an average rate of 3.5 acres per year. Studies should be undertaken to establish the relative abundance and seasonal dominance of these four species of submerged aquatic vegetation, for the extinction of turtle grass and clover grass may be eminent.

The 12,199-acre Brazoria National Wildlife Refuge has been a major, positive influence on the health and maintenance of the Christmas Bay ecosystem. The planned addition of 30,000 acres to the refuge will bring all of the Bastrop Bay shoreline into public ownership and further bay preservation. The presence of a hundred authorized cabins within the ecosystem has a negative impact on waterbird colonies, seagrass meadows, oyster reefs, and visual aesthetics.

Bastrop Bayou, Bastrop Bay, Drum Bay, Christmas Bay and Cold Pass function as an integral ecosystem. Drum Bay and Bastrop Bay would be valuable additions to the Christmas Bay Coastal Preserve.

## **Advance Identification Study of Bolivar Flats**

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Bolivar Flats is a wetland complex of marsh, tidal flats and shallow water located at the southwestern tip of Bolivar Peninsula in Galveston County, Texas. The area is known as a feeding area for large numbers of migratory shorebirds, and receives considerable human recreational use. The Environmental Protection Agency (EPA), in cooperation with other agencies, is conducting an Advance Identification (ADID) study on Bolivar Flats. The purpose of an ADID is to document the values and functions of selected wetlands areas and make the results available to the public. This information may be used in resource planning or regulatory decision-making, such as in Section 404 (dredge and fill) permit applications.

The ADID study utilized data on birds, benthos, fisheries, and human use. (Data were either previously existing or collected by other agencies for EPA). Bird use data includes surveys done from 1980-1989. Benthic data was collected in 1981-82; fisheries data in 1988. Human use surveys were done in 1981-82 and in 1988.

Bird surveys were made by scanning the flats with binoculars or spotting scope, identifying all species and counting all birds seen, estimating large numbers by eye. A total of 70 surveys were taken over 10 years by the U. S. Fish and Wildlife Service (USFWS). Surveys were not always regular, but most seasons were represented. The benthic survey was taken along a 500 m transect from the beach to about 50 cm depth msl. Monthly samples were taken by Ekman dredge collections of the top four cm of substrate, and individuals were picked, identified, and counted. A non-quantitative fish survey was conducted by the USFWS and Texas Parks and Wildlife Department (TPWD). The human use survey included type of use and number of people involved in a given use.

These data were utilized by the EPA to perform a Wetland Evaluation Technique, Version 2 (WET) to document all wetland functions and values. WET is a procedure designed to estimate the probability that a function or value will exist or occur in the wetland to an unspecified magnitude. WET evaluates the following functions and values: ground water recharge and discharge; flood flow alteration; sediment stabilization; sediment and toxicant retention; nutrient removal and transformation; production export; wildlife and aquatic diversity and abundance; uniqueness and heritage, and recreation. WET evaluates functions and values in terms of social significance, effectiveness (capability to perform a function), and opportunity to perform a function.

WET evaluates functions and values by characterizing the wetland in terms of predictors. Predictors are variables that are believed to correlate with the characteristics of the wetland and its surroundings. Responses to a series of questions are analyzed in a series of interpretation keys that reflect the relationship between predictors and wetland functions of values as defined in the technical literature. The keys assign a qualitative probability rating of HIGH,



MODERATE, or LOW to each function and value in terms of social significance, effectiveness, and opportunity.

## Results

The most important bird groups were shorebirds (sandpipers, plovers, and avocets), gulls and allies (e.g., terns and skimmers), and large waders (herons, ibises, and spoonbills). Most shorebirds were migratory and used the exposed flats for feeding during the winter stopover. Large waders fed in shallow water; gulls and allies used the flats mainly for roosting or loafing. Although there is considerable annual variation, peak use for shorebirds was in winter and early spring. The most abundant species were avocets (average annual peak 3,000), peeps (mostly western sandpipers, 2,400 peak), and dunlins (1,300 peak). Bolivar Flats may also be an important wintering area for the threatened piping plover. Piping plovers were seen regularly every year in considerable numbers (30-300).

Benthic macroinvertebrates were primarily polychaete worms (by numbers). There was low benthic diversity, with three species (*Streblospio benedicti*, *Capitella capitata*, and *Scololoplos foliosus*) accounting for most of the organisms. Density varied spatially and temporally, ranging from 0-22,000/ m<sup>2</sup>. Abundance peaked in April (7,600/m<sup>2</sup>) and stayed above 5,000 from February-June. Minimum abundance occurred in October and November (1,300-1,900/m<sup>2</sup>)

It is hypothesized that the shorebirds were utilizing the abundant supply of worms in the top few centimeters of sediment. Winter and spring are the seasons of peak abundance of both birds and worms. If the birds are consuming the worms, there is no immediate effect on worm populations, which remain high through June. Others workers have found that shorebirds do consume polychaetes on intertidal flats.

The fish survey yielded 29 species of finfish and shellfish. The most abundant species collected included bay anchovy (*Anchoa mitchilli*), Atlantic threadfin (*Polydactylus octonemus*), gulf menhaden (*Brevortia patronus*), grass shrimp (*Palaemonetes sp.*), and brown shrimp (*Penaeus astecus*). Oysters (*Crassostrea virginica*) were abundant in the tidal marsh sloughs.

Most significant human uses were sport fishing, bird observation and study, and beachcombing/general recreation.

The WET analysis rated sediment and toxicant retention, nutrient removal, wildlife wintering, and migration aspects of the habitat as "high" for effectiveness. Aquatic diversity and abundance, production export, and sediment stabilization were rated "medium." Floodflow alteration and wildlife breeding were rated "low".

In summary, Bolivar Flats provides valuable fish and wildlife habitat, particularly as a wintering ground and migratory stopover for several species of shorebirds. The area also has significant recreational value. Future management decisions affecting this area should take these findings into account.